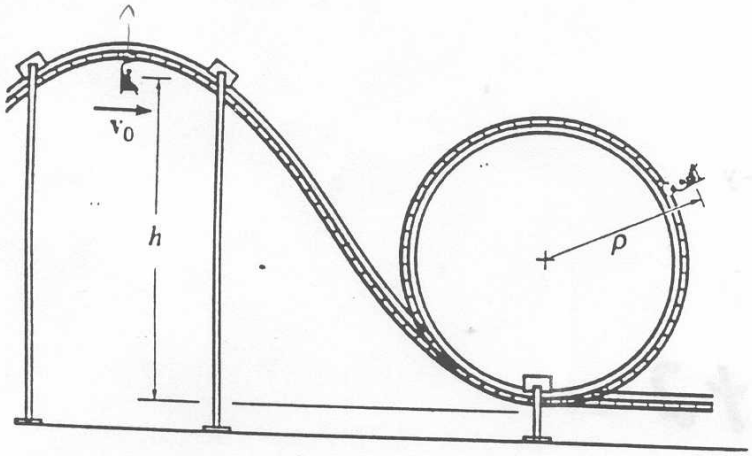
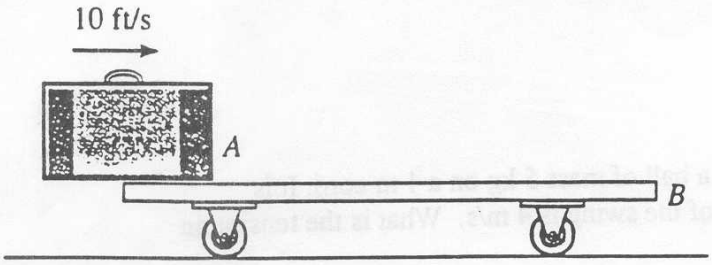
1 **(15 marks)** From a videotape it was observed that a place kicker for the Roughriders kicked a football 40 m in a measured time of 3.6 seconds. Determine the initial speed of the ball and the angle (to the horizontal) at which it was kicked. Also determine the radius of curvature of the trajectory just after the ball was kicked.

2 **(15 marks)** In a midway ride the riders are buckled into their seats. If the cars travel at $v_0 = 4$m/s when they are at the top of the hill, determine their speed when they are at the top of the loop and the reaction of the 70 kg rider on his seat at that instant. The car has a mass of 50 kg , h= 12 m and $\rho = 5$ m. (Neglect friction and the size of the car and passenger.)



3 **(15 marks)** The 20 lb cart B is supported on rollers. If a 10 lb suitcase is thrown horizontally onto it at 10 ft/s, determine the final speed of A and B and the length of time that A slides relative to B. The coefficient of kinetic friction between A and B is 0.4. (Ignore the size, mass and friction of the rollers.)



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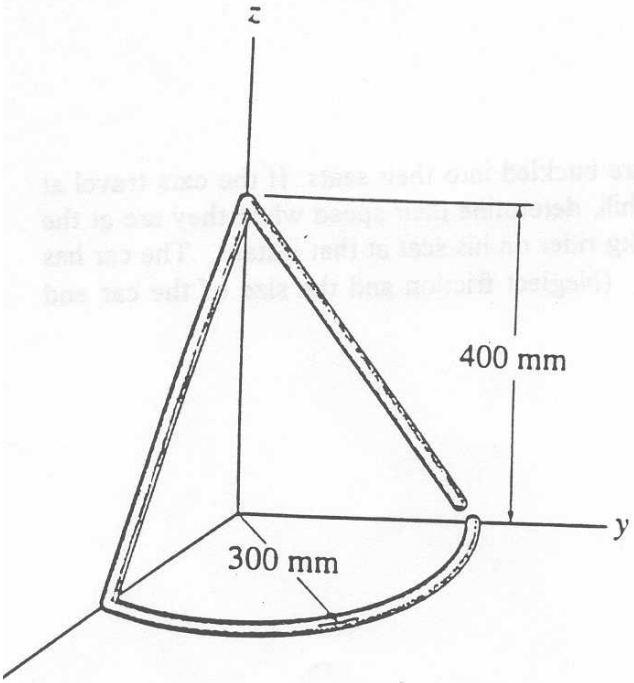
4 **(15 marks)** Locate the centroid of the homogeneous wire object. What would be the angle between the z axis and the vertical if the object were suspended from the top point?

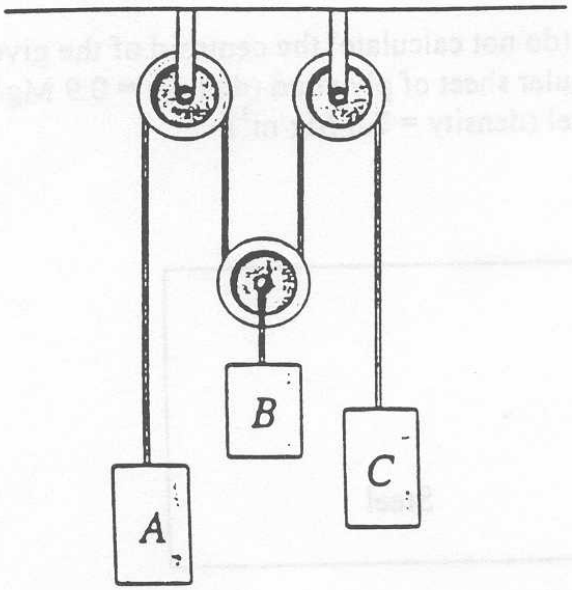


April 2001, Part 2

1. **(5 marks)** Particle A is moving with a velocity $\mathbf{v}_A = 3\,t\,\mathbf{i} + 2t^2\,\mathbf{j} - \sin(t)\,\mathbf{k}$ and particle B is moving with a velocity $\mathbf{v}_B = 2\,t\,\mathbf{i} - 3t^2\,\mathbf{j} - \sin(t)\,\mathbf{k}$ where t is in seconds. What is the relative acceleration of A with respect to B at t = 5 seconds?

2. **(5 marks)** A vertical pendulum consists of a ball of mass 5 kg on a 1 m cord. It is observed that the speed at the lowest point of the swing is 4 m/s. What is the tension in the cord at this point?

3. **(5 marks)** If block A is moving down at 3 m/s while block C is moving up at 4 m/s, determine the relative velocity of block B with respect to C.

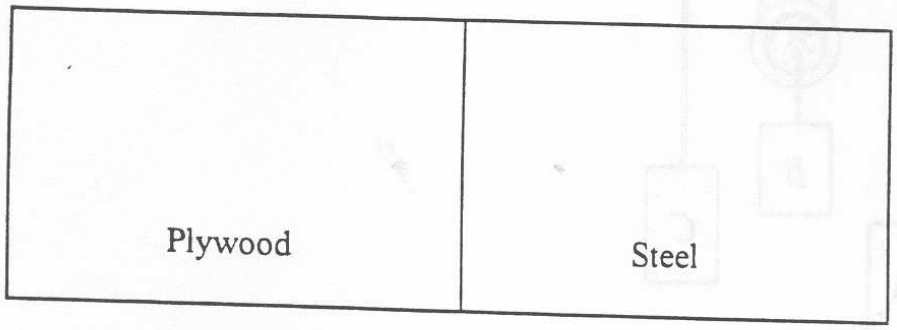


4. **(5 marks)** A car is traveling at a speed of 50 km/hr as it approaches a traffic light. When the light changes to red the driver slams on the brakes and skids before stopping. If the coefficient of friction between the tires and the road is 0.25 , how far would the car travel before stopping?

5. **(5 marks)** It is found that 3 kW is expended in dragging a 500 kg sled at a speed of 3 m/s. What is the coefficient of kinetic friction between the sled and the ground?

the horizontal and bounces at an angle of 40 degrees to the horizontal. What is the speed after the bounce?

7. **(5 marks)** Mark the approximate location (do not calculate) the centroid of the given object which is composed of a thin rectangular sheet of plywood (density = 0.9 Mg/m^3) connected to a thin rectangular sheet of steel (density = 7.8 Mg/m^3).



8. **(5 marks)** Determine the polar moment of inertia of a thin circular plate of radius r about an axis that passes through the circumference.